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Timber,
Forest Pest,
& Cooperative
Forestry
Management

Denver, Colorado

FOREST PEST CONDITIONS IN THE ROCKY MOUNTAIN REGION FOR 1987

FOREST PEST CONDITIONS

IN THE

ROCKY MOUNTAIN REGION

1987

By

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and
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April 1988

Timber, Forest Pest, and
Cooperative Forestry Management
Rocky Mountain Region
USDA Forest Service
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ACKNOWLEDGEMENTS

The Forest Pest Management (FPM) Staff of the Timber, Forest Pest, and Cooperative Forestry Management Unit extends appreciation to all cooperators who contributed information to this report.

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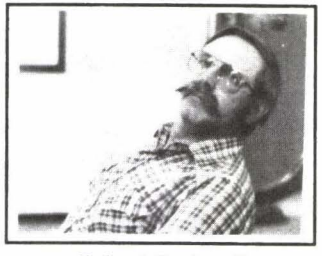

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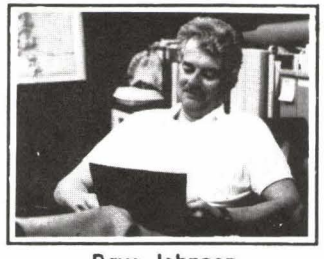

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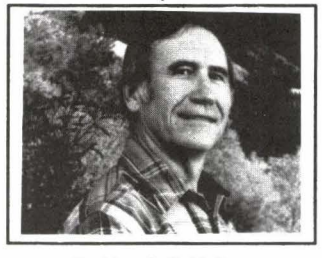

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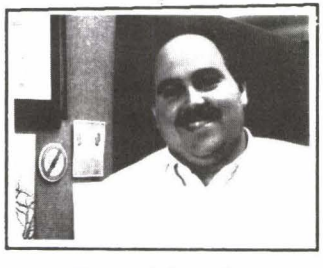

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INTRODUCTION

Forest Pest Management is responsible for detection, evaluation, prevention, and suppression of insects and diseases on forested Federal lands. Forest Pest Management also administers financial and technical assistance programs, which are available to State and private landowners of forested lands through the Cooperative Forestry Assistance Act of 1978 Public Law (95-313).

FOREST PEST MANAGEMENT WORKSHOPS AND TRAINING

A Forest Pest Management Workshop was conducted in Delta, Colorado, in May 1987, by Bernie Raimo, Diane Hildebrand, and Mike Sharon. The workshop emphasized recognition, management, and treatment of major forest pests in the Region. Staff from the Colorado State Forest Service (CSFS) assisted the U.S. Forest Service staff. CSFS specialists provided identification and treatment information on pest problems of ornamental and urban trees. Participants came from the U.S. Forest Service, Bureau of Land Management, and U.S. Park Service.

In cooperation with the Colorado State Forest Service, a dwarf mistletoe seminar was held July 18 in the Black Forest, Colorado. Approximately 100 private landowners attended the discussion, which covered the biology and control of ponderosa pine dwarf mistletoe.

A western bark beetle semiochemicals workshop was conducted in Lakewood in January 1988. The workshop objective was the development of a westwide plan to standardize the use of semiochemicals for bark beetle management. Semiochemicals have high potential as beetle management tools, but field practice by the U.S. Forest Service has been minimal so far.

A workshop on the use of the growth regulator ethephon for reducing dwarf mistletoe spread was held in Lakewood in March 1988. The purpose of the workshop was to review past pilot tests of the chemical and develop standards for future use throughout the West. Cooperation between Forest Pest Management, research, and industry was emphasized for additional tests.

DISEASE AND INSECT CONDITIONS IN BRIEF

Lodgepole pine dwarf mistletoe and comandra blister rust continued as the most damaging disease agents in the Rocky Mountain Region. Survey and suppression activities for lodgepole pine dwarf mistletoe have been continued in Colorado and Wyoming. Presuppression surveys were conducted on 3,554 acres on three National Forests. Silvicultural control was applied on 4,468 acres on eight National Forests.

Root diseases are being monitored at a limited number of sites in the Region. Although annual losses are not known, it is suspected that they are causing a reduction in the resource in the form of growth loss and mortality.

The mountain pine beetle and western spruce budworm are still top-ranking as the most notable damaging insects in the Region. Budworm impact on annual growth and mortality to Douglas-fir continue to be monitored in permanent plots. A work plan and Environmental Assessment (EA) to monitor the impact of various silviculture treatments on budworm survival were completed. Pre-treatment sampling is to begin this year (1988), as well as the first sale in the demonstration area east of the Rampart Range road on the Pike National Forest.

Gypsy moth infestations in several communities along the Front Range of Colorado has spurred a growing concern. The number of moths caught have increased yearly.

The use of pesticides continues as an important part of integrated pest management. Pesticides are valuable tools in forest tree nursery management and control of noxious weeds and undesirable vegetation in range management. More than 7,000 acres were treated with herbicides in 1987.

The major cover types in Region 2 have age class distributions which are not conducive to a healthy forest. In all cases, the majority of the trees in a cover type are approaching maturity. Insects and diseases are expected to be a driving force, along with fire, in modifying the current vegetation.

DOUGLAS-FIR COVER TYPE

Figure 1 displays the percent of area by age class for the Douglas-fir cover type in Region 2 (from the Resource Inventory System database). Of the estimated 1.1 million acres of cover type of National Forest lands, 80 percent of the acres are between 81 and 180 years of age. There are an estimated additional 2.0 million acres of Douglas-fir cover type on other Federal, State, and private lands in the Region.

On average, only 1.3 percent of the acres have been regenerated per decade over the past 80 years. In the northern and central Rockies, diameter and height growth are negligible beyond 200 years of age. Nearly 5 percent of the cover type is beyond 200 years of age. Rocky Mountain Douglas-fir rarely lives beyond 400 years of age. The average annual volume harvested in the Region is about 3.4 million board feet (about 1.5 percent of the total Regional volume).

INSECTS AND DISEASES THAT AFFECT THE DOUGLAS-FIR COVER TYPE

Western spruce budworm: Choristoneura occidentalis Freeman

Aerial reconnaissance surveys for budworm date back to 1960. A brief summary and graph, Figure 2, of the budworm trend throughout the Region since 1960 is provided:

1960 - 1963: Acres infested averaged 579,000 $\pm$ 33,000.

1963 - 1975: Infestations declined and remained relatively low - 98,000 $\pm$ 10,800 infested acres.

1976 - 1983: Acres infested increased steadily until a high of about 2.7 million acres was reached in 1983.

1984 - 1986: Again, a decline in acres infested dropped more than two-fold to 1.1 million acres. But the level of the infestation remain much higher than in the middle 60's and early 70's. Approximately 20,000 acres of state/private land were treated aerially with insecticides.

1987: Populations continued to subside in Colorado and Wyoming for the fourth consecutive year. An estimated 848,000 acres were visibly defoliated.

About 8,000 acres of State and private land were aerially treated with pesticides in mountain communities along the Front Range of Colorado. For the first time, the microbial insecticide Bacillus thuringiensis (B.T.) was reportedly used more than conventional chemical formulations.

Pheromone traps were deployed at permanent plots to detect the presence of budworm moths. The plots were established in a variety of Douglas-fir habitat types/elevational ranges. In the future, egg mass surveys will probably be replaced with baited traps to monitor budworm population trends and to determine the level of correlation between trap catches and defoliation levels.

The western spruce budworm is a native insect that has been part of the Douglas-fir ecosystem for thousands of years. With the Douglas-fir cover type comprised primarily of old, uneven-aged stands, the budworm is expected to continue as a significant concern in the Region.

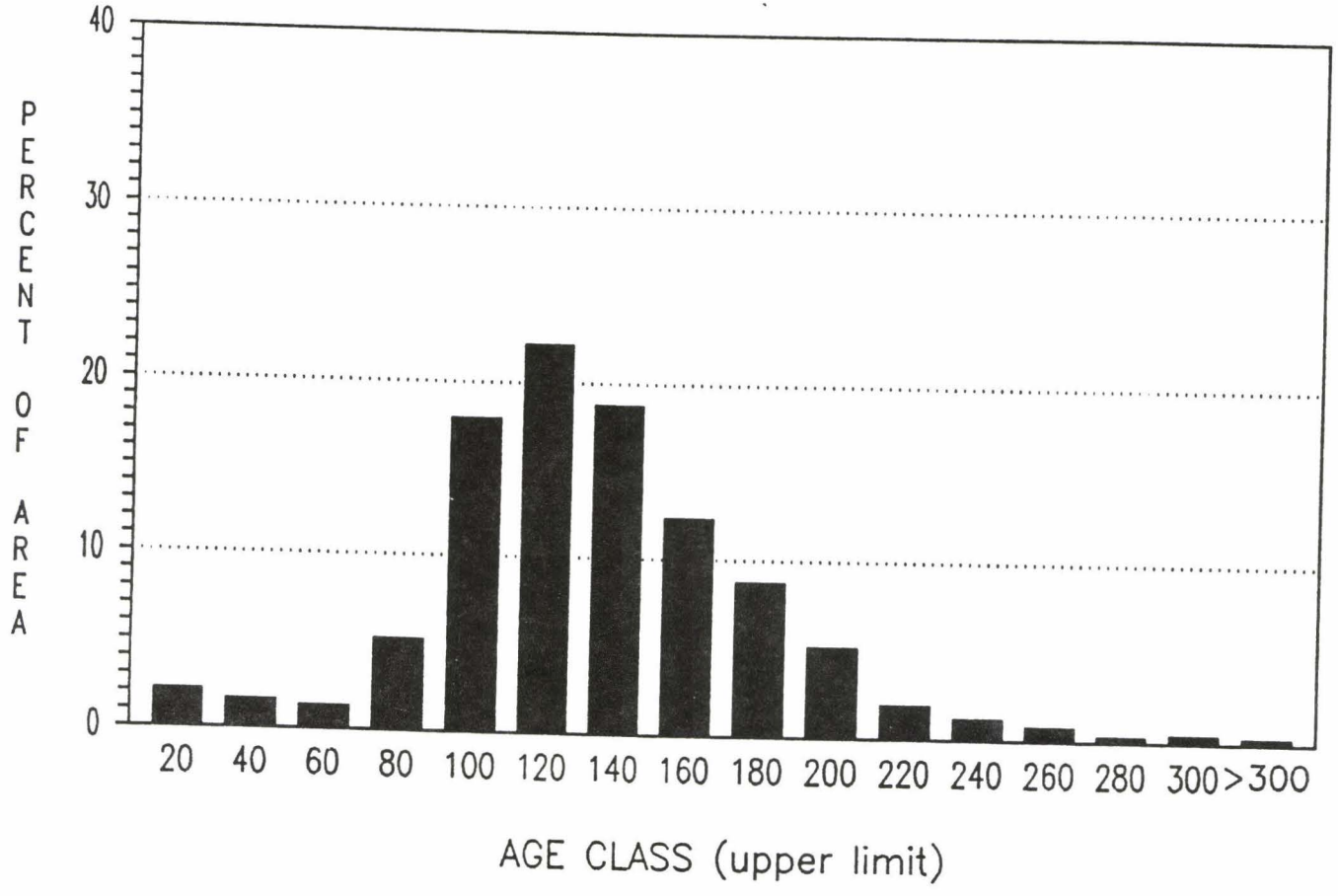

Figure 1: Percent of Douglas-fir covertype by age class in Region 2.

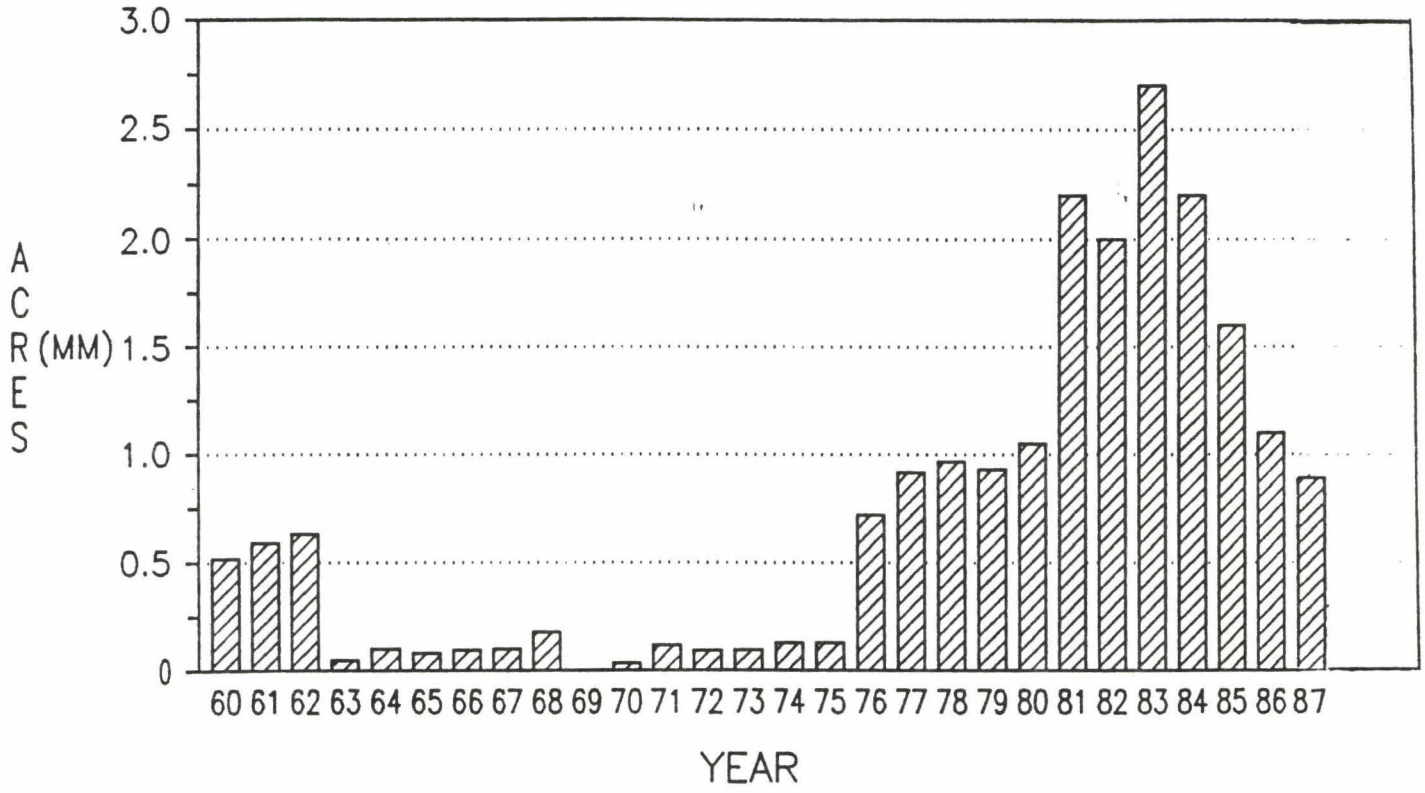

Figure 2 : Western spruce budworm defoliation in Region 2, from 1960 to 1987.

Douglas-fir tussock moth: Orgyia pseudotsugata McDunnough

Prior to the 1980's, the only significant tussock moth (DFTM) outbreak occurred in the Rocky Mountain Region in 1937. That outbreak killed trees on about 200 acres near Colorado Springs.

1975 - 1976: Detection surveys, using pheromone-baited sticky traps, were conducted in forested areas along the Colorado Front Range. Some moths were caught but no associated damage reported.

1977: Detection surveys were expanded into Wyoming. Moths were captured at several trapping sites, but again, no areas of feeding damage were discovered.

1982: Several ornamental spruce at Evergreen, Shaffer's Crossing, Conifer, and the western outskirts of the Denver metropolitan area of Colorado were defoliated by DFTM. These isolated occurrences, in mountain communities west of Denver, were adjacent to hundreds of acres of natural stands of Douglas-fir that were not affected by this insect.

1983 - 1986: Several small stands of Douglas-fir were severely defoliated by DFTM along the Platte River drainage, Pike National Forest. In 1986, 50 permanent plots were established to monitor DFTM to assess population trends over a range of elevations and plant associations.

1987: An additional 100 permanent plots were established to monitor moth populations and analyze population behavior over time.

The DFTM trapping program will ultimately provide the following:

- a foundation to assess competitive interactions between DFTM and western spruce budworm;

- an indication of significant DFTM population changes which can lead to more intensive sampling in determining whether to treat or not;

- a statistical determination of the relationship between number of DFTM adults trapped, larval densities, and consequent host tree defoliation in order to better understand DFTM under Region Two conditions.

Douglas-fir beetle: Dendroctonus pseudotsugae Hopkins

Douglas-fir beetle-caused mortality has continued to increase since 1982. Continued stress to Douglas-fir, mainly from perpetual budworm feeding, is expected. Increasing acreages of budworm riddled stands are at risk of a major Douglas-fir beetle outbreak throughout the budworm/Douglas-fir range. Much of the mortality is occurring on steep or inaccessible lands.

The following 5-year history summarizes Douglas-fir beetle in the Region:

1982: Scattered tree mortality reported in Colorado and Wyoming at endemic levels.

1983: Losses to the beetle were increasing in Colorado; larger groups of mortality became more apparent - the most notable continuous mortality at Douglas Pass between Grand Junction and Rangely in Western Colorado. About 20,000 acres of private/BLM lands were affected. Increases were noticed in areas of budworm feeding on Roosevelt National Forest, but the correlation between budworm damage and incidence of beetle attacks remained unknown.

Scattered mortality was also noted on the Gunnison, San Juan, and White River National Forest in Colorado and the Bighorn Mountains in northern Wyoming.

1984: Increased mortality occurred in areas of intense budworm defoliation. Along the Colorado Front Range, nearly 2,300 acres containing beetle-killed Douglas-fir were detected.

1985 - 1987: Beetle mortality reported common along Front Range and increasing near the Blue Mesa Reservoir on the western slope. It was confirmed that beetle mortality occurred primarily in areas that sustained heavy budworm feeding for 5-10 years. Areas of particular heavy infestations include:

Poudre Canyon
Thompson Canyon
Red Feather Lakes
Magnolia (Boulder County)
South St. Vrain Canyon
Ute Pass/Pikes Peak
Conifer

Colorado State Forest Service reported approximately 150,000 trees infested on the Front Range with surprisingly little public concern. Control is not feasible at this stage on the majority of the infested areas.

Douglas-fir dwarf mistletoe: Arceuthobium douglasii Engelm.

Dwarf mistletoe occurs on Douglas-fir in the southern two thirds of Colorado. Suppression projects were funded by FPM for treatment of 200 acres on the Rio Grande National Forest.

PONDEROSA PINE COVER TYPE

Figure 3 displays the percent of area by age class for the ponderosa pine cover type in Region 2. Of the estimated 1.9 million acres of cover type on National Forest lands, 78 percent of the acres are between 61 and 140 years of age. There are an estimated additional 800 thousand acres of ponderosa pine cover type on other Federal, State and private lands in the Region.

On average, only 4 percent of the acres have been regenerated per decade over the past 80 years. Ponderosa pine can live to 600 years of age but are generally considered to be mature at about 150 to 225 years and over-mature beyond 225 years. About 10 percent of the ponderosa pine cover type in the Region is mature or over-mature. The annual volume harvested in the Region is about 106 million board feet (about 46.5% of the total Regional volume.

LODGEPOLE PINE COVER TYPE

Figure 4 displays the percent of area by age class for the lodgepole pine cover type in Region 2. Of the estimated 2.3 million acres of cover type on National Forest lands, 80 percent of the acres are between 80 and 180 years of age. There are an estimated 1.0 million acres of lodgepole pine cover type on other Federal, State and private lands in the Region.

On average, only 2.5 percent of the acres have been regenerated per decade over the past 80 years. Stands at lower elevations start deteriorating at 80 to 100 years, but lodgepole pine can reach 600 years under ideal conditions. About 80 percent of the lodgepole pine cover type in the Region is in excess of 80 years of age. Average annual volume harvested in the Region is about 46 million board feet (about 20.0% of the total Regional volume).

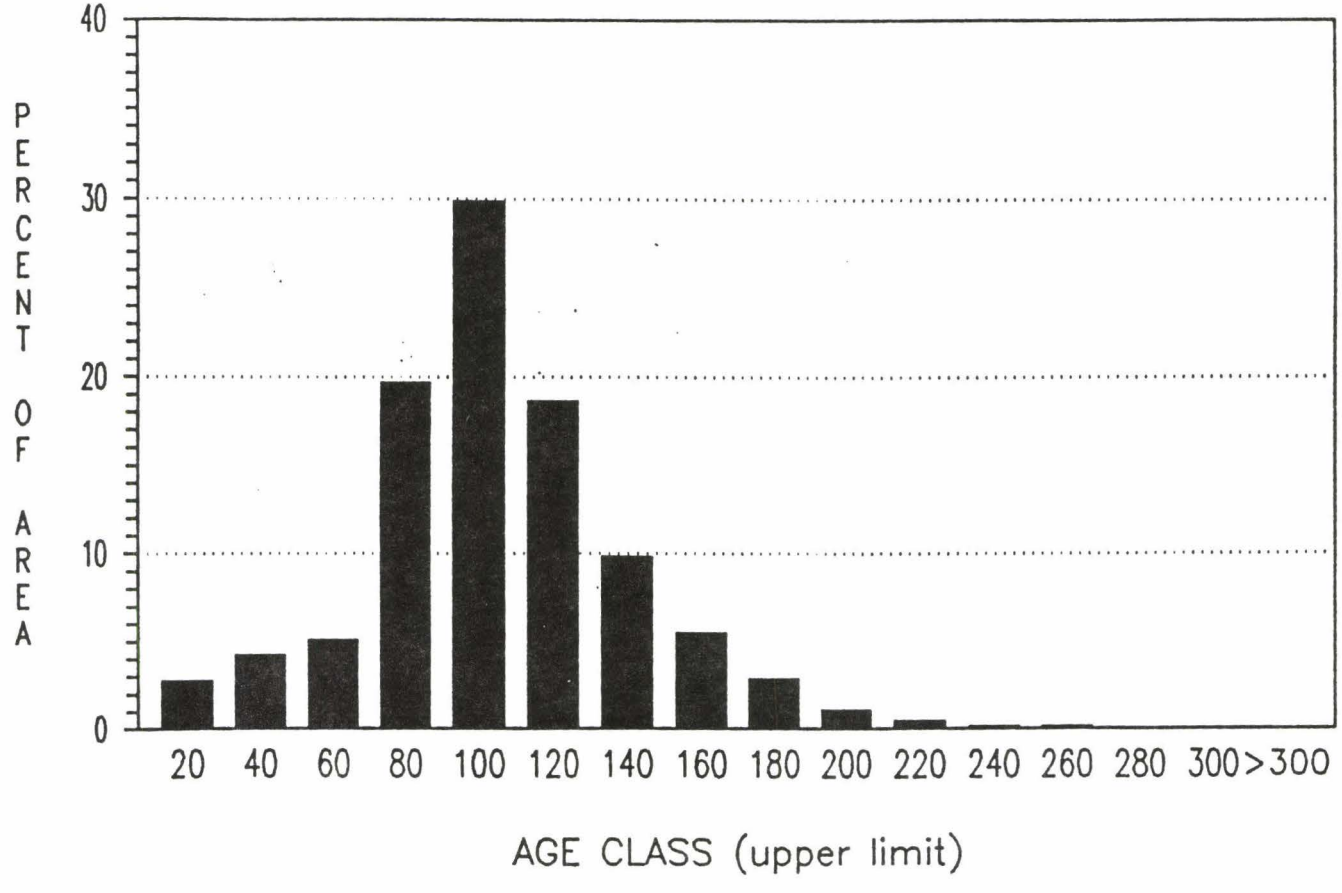

Figure 3: Percent of ponderosa pine covertype by age class in Region 2.

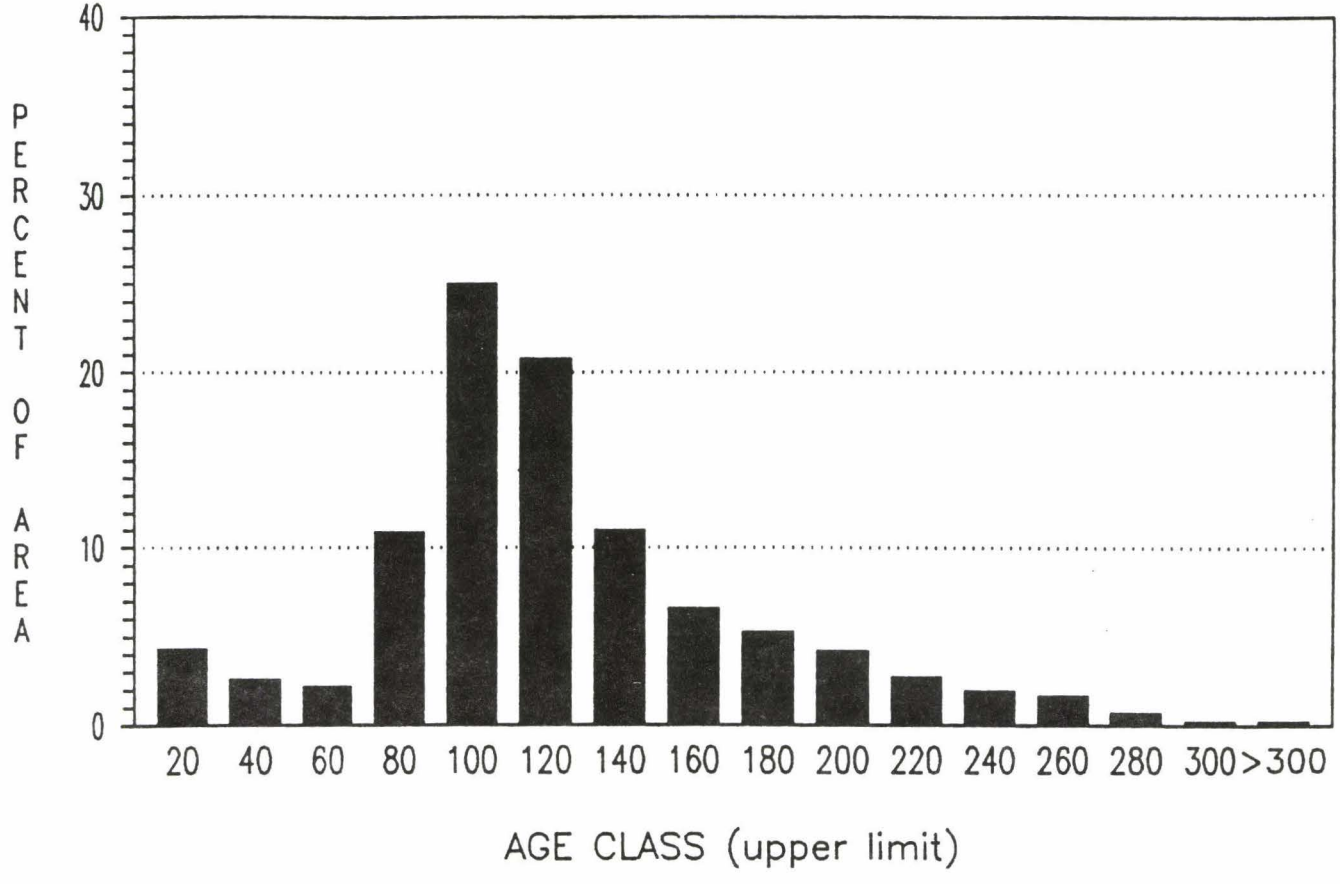

Figure 4: Percent of lodgepole pine covertype by age class in Region 2.

INSECTS AND DISEASES THAT AFFECT LODGEPOLE AND PONDEROSA PINE COVER TYPES

Mountain Pine Beetle: Dendroctonus ponderosae Hopkins

Colorado: Mountain pine beetle populations continue on a downward trend as they have Regionwide for the past 2 years. Some significant areas of 1987 beetle-caused mortality include 40,000 trees (184 MCF) mainly in Eagle, Grand, and Summit Counties. On the Uncompahgre Plateau, 16,000 ponderosa pine (74 MCF) were killed. On the White River National Forest, the once epidemic level of mortality is now reduced to a few hot spots along the Blue River drainage north of Dillon Reservoir.

Wyoming: Beetle populations remained static between 1985 and 1987. Management practices on Casper Mountain by the Mountain Pine Beetle Association appear to help reduce beetle-caused losses and wildfire potential. A recent mountain pine beetle survey on Casper/Muddy Mountains showed beetle attacks were about 0.85 trees per acre on Casper and 7.4 trees per acre on Muddy Mountain. This represents an 18 percent decrease in attacks on Muddy Mountain since 1986. Pest management entomologists recommend the same silvicultural treatments done on Casper Mountain be expanded to include Muddy Mountain to more effectively reduce losses to mountain pine beetle throughout the area.

Elsewhere in Wyoming, outbreaks occurred along the east face of the Bighorn Mountains (BLM land) and appear to be increasing. Some increases in beetle mortality have occurred around Laramie Peak on the Medicine Bow National Forest. MPB has been present, and gradually increasing, in that area over the past 5 years. Total losses in Wyoming: 49,000 trees (220 M cu. ft.) over 12,400 acres.

South Dakota: Mountain pine beetle remained at low levels in the Black Hills in 1987. Some buildup has occurred in scattered pockets. About 6,500 (30 M cu. ft.) trees over 2340 acres were infested according to aerial observations.

Pine Engraver Beetle: Ips sp.

South Dakota: Ips populations have increased probably due to the drier than normal weather experienced this past year. This trend is expected to continue.

HIGH COUNTRY PROJECT

The High Country Integrated Pest Management Project (HCP) began in Summit and Upper Eagle Counties (originally SUE) in 1981. The project was expanded to include all of Eagle and Grand Counties in 1983. The goals of this project are to:

1. Minimize adverse impacts of mountain pine beetle, by establishing insect and disease resistant forests.
2. Maintain or improve scenic and recreation qualities.
3. Maintain or improve wildlife habitats.
4. Reduce wildfire hazards.
5. Salvage infested and dead lodgepole pine.

The Colorado State Forest Service reported 31,000 acres were surveyed before and after suppression. A total 5,500 trees (70,950 cu. ft.) were treated with silvicultural and mechanical methods and 500 trees (6,450 cu. ft.) with chemical methods. Sixty-five acres of private land were treated with mountain pine beetle-attracting baits. After data analysis is completed, results of the MPB trapping tests will be provided in the FY 88 Conditions Report.

ROOT DISEASES: Armillaria sp. and Fomes annosus (Fr.) Cke.

At endemic levels, mountain pine beetle tends to select Armillaria sp. infected trees. These trees then become the focal point for epidemic population build-up. This association between bark beetles and root disease has been noted especially in the Black Hills in South Dakota.

Although annual losses to root diseases are not known, it is suspected that they reduce the timber resource in the form of growth loss and mortality. Armillaria and annosus root diseases cause the most mortality in thinned and cut stands where old infected roots and stumps remain as sources of inoculum.

COMANDRA BLISTER RUST: Cronartium comandrae Pk.

Comandra blister rust continues to be the most serious disease of lodgepole pine on the Wind River Ranger District, Shoshone National Forest. More than half of the mature trees are infected and 85 percent of the infected trees have dead tops. The Forest is incorporating the results of recently completed research on growth loss projections into management of infested stands.

DWARF MISTLETOES: Arceuthobium spp.

Approximately 20 percent of the ponderosa pine type is infested with dwarf mistletoe, A. vaginatum (Willd.) Presl. subsp. cryptopodum (Engelm.) Gill. Annual losses amount to over 885,000 cubic feet. Presuppression survey and suppression projects are being funded by FPM on 1,173 acres of mixed ponderosa pine and lodgepole pine on the Pike and San Isabel National Forests.

Lower montane and foothills ponderosa pine in Colorado is heavily infested with dwarf mistletoe. These forested acres are mostly privately owned.

Action plans for survey and suppression of lodgepole pine dwarf mistletoe, A. americanum Nutt. ex Engelm., have continued throughout the Region. Presuppression surveys were conducted on 2,654 acres on the two National Forests. Cultural control was conducted on 3,995 acres on the six National Forests (Table 1).

TABLE 1. ACRES OF PRESUPPRESSION SURVEYS AND SUPPRESSION PROJECTS FUNDED BY FPM AND CONDUCTED IN 1987 FOR DWARF MISTLETOE ON FEDERAL LANDS, MOSTLY IN LODGEPOLE PINE TYPE.

National Forest	Presuppression Survey Acres	Suppression Project Acres
Pike & San Isabel *	900	273
Arapaho & Roosevelt	363	763
Grand Mesa, Uncompahgre & Gunnison	--	400
Medicine Bow	2,291	1,856
Rio Grande **	--	200
Routt	--	601
Shoshone	--	196
White River	--	179
TOTALS	3,554	4,468
Bureau of Land Management (USDI)		
Colorado	4,850	194
Wyoming	10,000	77
TOTALS	14,850	271

* Mixed between lodgepole pine dwarf mistletoe and ponderosa pine dwarf mistletoe.

** Primarily Arceuthobium douglasii on Douglas-fir.

Control of Dwarf Mistletoe with Ethephon

A cooperative research project with the North Central Forest Experiment Station, Rocky Mountain Forest and Range Experiment Station, Arapaho and Roosevelt National Forests, and TFP&CFM (R-2) to evaluate the potential use of ethephon an ethylene-releasing plant growth regulator, as a control for two dwarf mistletoes: Arceuthobium americanum on Pinus contorta and A. vaginatum subsp. cryptopodum on P. ponderosa in Colorado, looks promising. Ethephon at 2,500 ppm with a surfactant was tested using three application methods: A bottle sprayer, a backpack mistblower, and a hydraulic sprayer. Dwarf mistletoe shoot abscission rates of 74 to 100 percent were consistently achieved using these ground application methods. Mistletoe seed dispersal the year after ethephon application was much less in the treated plots than in the nontreated control plots. An evaluation of aerial application methods is in progress. Results will be reported soon.

Additional evaluations under forest conditions are planned in 1988.

North Park Dwarf Mistletoe Study

In North Park, Colorado, a cooperative (RMFRES and RM Region) study of sanitation and thinning treatments for dwarf mistletoe-infected lodgepole pine was summarized. A 21-year examination was made of the 37 one-half acre plots established in 1965. The stands are in three age classes, now about 40, 50 and 60 years old.

The proportion of trees infected in untreated plots increased from 28 percent in 1965 to 53 percent in 1986. In treated plots, 30 percent of the trees were infected in 1965; this level was reduced to essentially zero as all visibly infected trees were removed in 1965 and 1968. In 1986, 26 percent of the trees were infected, or less than half that in the untreated plots.

Differences in ratings of average stand dwarf mistletoe intensity (6-class DMR system, Hawksworth 1977) between untreated and treated plots from 1965 to 1986 were even more marked: Stand DMR increased from 0.6 to 1.4 in the untreated plots, whereas it fell from 0.6 to 0.3 in the treated plots. Such low levels of infection on treated plots will result in little effect on tree growth for several decades.

Projections using the RMYLD growth and yield simulation program suggest that volume growth in treated stands will be much greater than that in the untreated stands. For example, the treated stands will produce an estimated 2320 merchantable cubic feet per acre in 60 years, compared to a projected 680 merchantable cubic feet per acre in the untreated stands. These preliminary results confirm that sanitation and thinning can significantly increase yields in young, mistletoe-infested lodgepole pine stands.

NEEDLECASTS: Lophodermella concolor (Dearn.) Darker

Lodgepole pine needlecasts, caused by various fungi including Lophodermella concolor (Dearn.) Darker and L. montivaga Petrak, were widespread along the Arapaho and Routt National Forests. This is the third year that needlecasts have been observed, probably as a result of weather conditions favorable for infection.

ASPEN COVER TYPE

Figure 5 displays the percent of area by age class for the aspen cover type in Region 2. Of the 1.5 million acres of cover type on National Forest lands, 78 percent are between 61 and 120 years of age. There are an estimated additional 1.1 million acres of cover type on other Federal, State, and private lands in the Region.

On average, only 6.0 percent of the acres have been regenerated per decade over the past 80 years. Pathological rotation is usually considered to be 80 to 90 years of age. About 52 percent of the cover type is beyond 80 years. With more than half of the cover type beyond pathological rotation, insects and diseases are expected to perform a primary role in aspen stand deterioration. If the current extent of the aspen cover type is to be maintained, then 12.5 percent of the acres (330,000) need to be regenerated per decade. Under current management levels, the acres of aspen cover type are expected to decline by 6 to 7 percent per decade. These acres will probably succeed to more tolerant species, such as spruce and fir. The average annual volume harvested in the Region is about 6.9 million board feet (about 3.0 percent of the total Regional volume).

INSECTS AND DISEASES THAT AFFECT THE ASPEN COVER TYPE

Western Tent Caterpillar: Malacosoma californicum Packard

1978-1985: Populations and associated defoliation continued to build yearly until 1984. By then, cumulative defoliation had peaked at 94,000 acres mostly on the San Juan National Forest and adjacent private land. By 1985, the population dropped drastically and 31,000 acres were defoliated.

1986-1987: Tent caterpillar defoliation was negligible for both years. The sudden decline in population between 1984 and 1987 is likely due to natural factors i.e. predator/parasites, nucleopolyhedrous virus.

Gypsy Moth: Lymantria dispar (Linnaeus)

The gypsy moth is becoming a more serious threat to our Region. Recently established gypsy moth populations in Boulder and Fort Collins increased significantly in 1987. New introductions were detected in Wheatridge, Colorado Springs, Mount Rushmore, Laramie, and at two locations near Cody.

Each year since 1982, Forest Pest Management has provided gypsy moth traps to the National Forests for placement in recreation sites with suitable gypsy moth habitat. No moths have been found on National Forest System lands. However, the threat the gypsy moth poses to our forest resource as well as the socio-political interest that this insect attracts wherever it occurs cannot be overstated. The insect feeds on over 200 species of plants. In the infested areas of the eastern United States, oak, aspen willow, and cottonwood rank high on the insect's preferred host list. In Colorado, there are over 300,000 acres of oak type and over 2 million acres of aspen type. The number of acres of susceptible mixed type is undetermined. A brief history of gypsy moth in the Region follows.

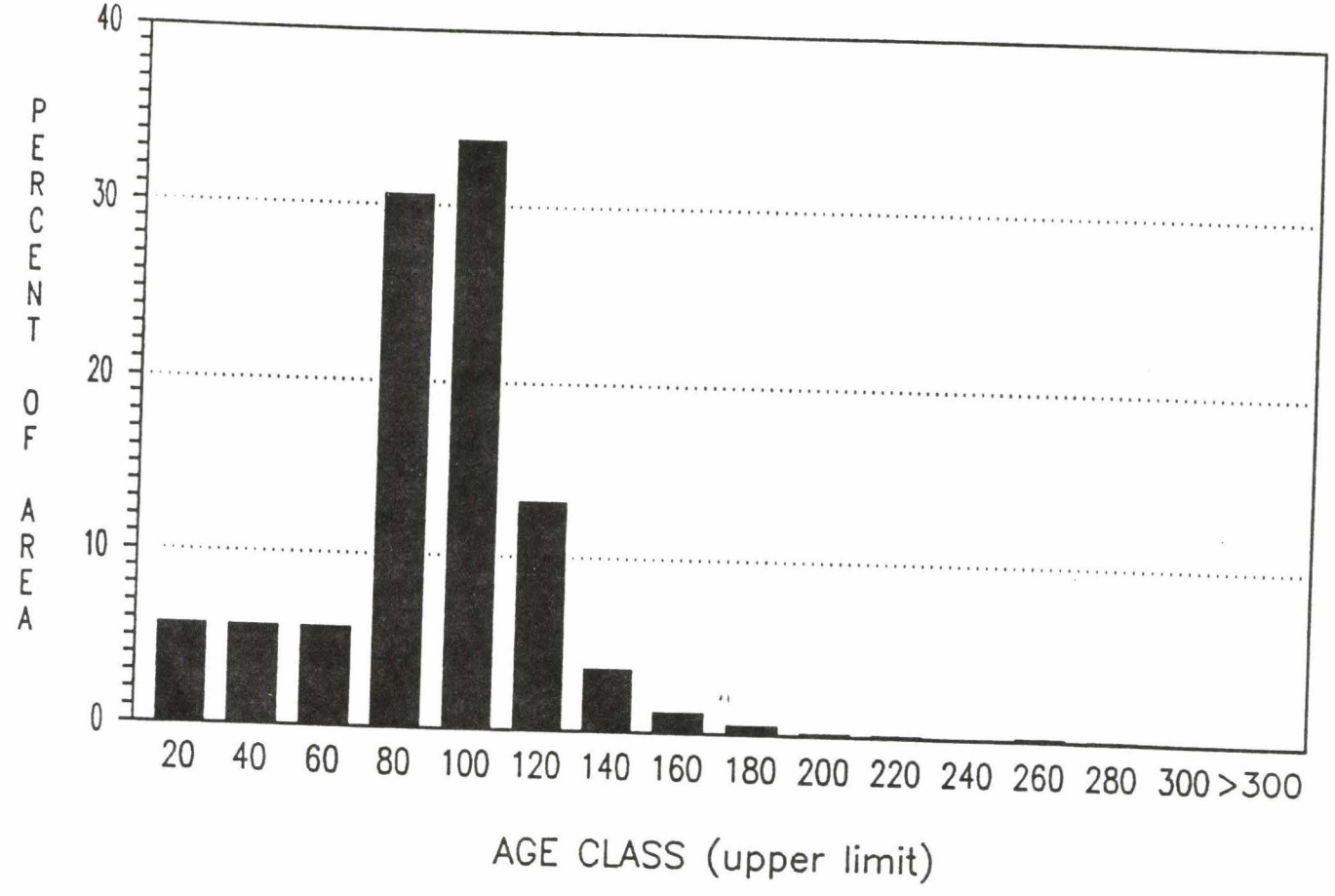

Figure 5: Percent of aspen covertype by age class in Region 2

Colorado

Colorado's first gypsy moth catch occurred in 1984 in Rocky Mountain National Park and consisted of a single male. Intensive searching for egg mass and subsequent high density trapping has failed to produce additional gypsy moths for the Park. It is now thought this "infestation" was probably a single "hitch-hiking" moth.

In 1985, moths were captured in Boulder and Fort Collins. In Boulder, 2 traps out of 20 caught moths -- 10 moths in one trap and 2 in another. In Fort Collins, 4 traps out of 20 caught one moth each. Egg mass searches were conducted in the vicinity of all positive traps. No eggs were found.

For the 1986 trapping, out of 185 traps in Boulder, 13 caught moths. A total of 46 moths were caught in Boulder over an area of about 0.5 square miles. In Fort Collins in 1986, out of 197 traps, 15 caught a total of 57 moths. The area with positive traps in Fort Collins was about 1.7 square miles. The Fort Collins positive traps were clustered in two separate neighborhoods about two miles apart. Intensive egg mass searching in the vicinity of all the positive traps revealed nothing.

In 1986, a steering committee was formed which included representatives from the USDA Forest Service, Animal and Plant Health Inspection Service, the Colorado State Forest Service, the Extension Service, the State Department of Agriculture, and the Sierra Club. The Colorado State Forest Service was designated the lead agency.

1987 - Fort Collins: In March and April, 300 residential lots within the 1986 positive trap area were searched for egg masses. Two old egg masses were found.

Between June 4 and July 10, 1,630 traps were deployed. Later in the summer, 21 additional traps were deployed. Of these, 37 were considered detection traps that were placed around the periphery of the city at a density of about 1 per square mile. An additional 307 delimitation traps ringed the two core infestations at a density of 20 per square mile. A mass trapping area (approximately 3 traps/acre) was created within each of the 2 infested areas identified in 1986. Moths began showing up in traps about July 20. The peak moth flight seemed to occur in early August. The last moths were caught in late August or early September.

A total of 124 males were captured in the west side infestation. The most moths caught in one trap was 20. Other life stages found in the west side infestation were: 27 female moths, 20 pupae, about 45 new egg masses, and 1 larva. Minor defoliation thought to be caused by gypsy moth was observed on an apple tree within the west side infestation.

Within the east side infestation, 77 males were caught. Other life stages found were 5 females and 2 new egg masses.

In summary, 1,651 traps were deployed in Fort Collins. A total of 203 male moths were caught in 51 traps. Other life stages found were: 32 females, 20 pupae, 1 larva, and 47 new egg masses.

1987 - Boulder: An egg mass search of 175 properties within the 1986 positive trap area turned up 1 old egg mass.

A total of 1,169 traps were deployed. Captured in 43 traps were 144 adult moths. Other life stages found were: 15 female moths, 1 pupa, and 111 new egg masses.

1987 - Denver Metro Area: A total of 667 traps were deployed by the Colorado State Forest Service. A new infestation was found in the west Denver suburb of Wheatridge. One trap caught 14 moths and another caught 25 moths.

1987 - Colorado Springs: 200 traps were deployed in Colorado Springs. One trap produced a single moth.

1987 - Other Areas: Approximately 200 traps were placed at National Forest campgrounds throughout the State, with negative results.

400 traps were distributed to CSFS District Offices and 52 traps were given to private company cooperators, also with negative results.

A summary of the gypsy moth program on State and private lands in Colorado from 1985 to 1987 is presented in Table 2.

1988 Plans: In Fort Collins and Boulder, mass trapping will again be employed, but will be supplemented by other efforts, such as spraying and/or the induced inherited sterility technique. The actual mix of options chosen will depend on funding, further analysis of 1987 results, and consultation with other gypsy moth programs. Quarantines are a possibility in 1988.

In Wheatridge and Colorado Springs, delimitation trapping is planned for both areas. Spraying in these areas is not anticipated.

Detection trapping is planned for most of the larger cities and towns in Colorado in 1988 and trapping will be continued on National Forest campgrounds.

Table 2. Summary of Gypsy Moth Trapping Program on State and Private Lands in Colorado, 1985-1987

	1985	1986	1987
Total Traps Deployed	2,662	2,800	4,137
Total Positive Traps	6	28	96
Total Moths Trapped (Or caught by hand)	16	103	387
Female Moths	0	0	47
Pupae	0	0	21
New Egg Masses	0	2	58
Larvae	0	0	1

South Dakota

South Dakota Department of Agriculture has been active in the gypsy moth detection program since 1982. Moths were caught during that first year at Fourmile, southwest of Custer. In 1983, moths were caught in Custer; in 1984, at Mount Rushmore National Monument and the Reptile Gardens, south of Rapid City; 1985 at Keystone and Custer State Park. In 1986, no moth catches were reported for the first time since the detection program began.

In 1987, 2 single moth captures were reported. Both were in campgrounds, one at Keystone, one on the outskirts of Rapid City.

Kansas

In 1982, male gypsy moths were reported for the first time in the state. An undetermined number were captured in Bourbon County. In 1986, 672 pheromone traps were deployed and one moth was caught in Wyandotte County.

In 1987, traps were placed in timbered locations suitable for moth establishment in eastern Kansas, but no moths were caught.

Wyoming

Three male moths were caught in traps placed by APHIS personnel, one each in Laramie, Jackson, and west of Cody, Wyoming, in the Clarks Fork Canyon.

Foliage Diseases

Aspen foliage diseases were of particular significance in 1987, especially Marssonina blight. This disease tends to be very cyclic. In 1987 thousands of acres west of the Continental Divide were affected by the disease. Early infections and premature leaf drop adversely effected the beauty of the fall foliage. The disease was especially heavy in Delta, Eagle, Grand, Gunnison, Mesa, Montrose, Ouray, and Routt Counties.

Canker Diseases

Since aspen has living bark, it is susceptible to many canker diseases. Any mechanical wounding usually leads to canker disease and eventual death of the stem. When aspen stems are killed slowly by disease, sprout production tends to be greatly reduced. For these reasons, partial cutting of aspen is not recommended. Establishment of new campgrounds or picnic grounds in aspen stands is also discouraged.

SPRUCE/FIR COVER TYPE

Figure 6 displays the percent of area by age class for the spruce/fir cover type in the Region. Of the estimated 3.3 million acres of cover type on National Forest lands, 76 percent of the acres are between 81 and 220 years of age. There is an estimated 1.6 million acres of spruce/fir cover type on other Federal, State, and private lands in the Region.

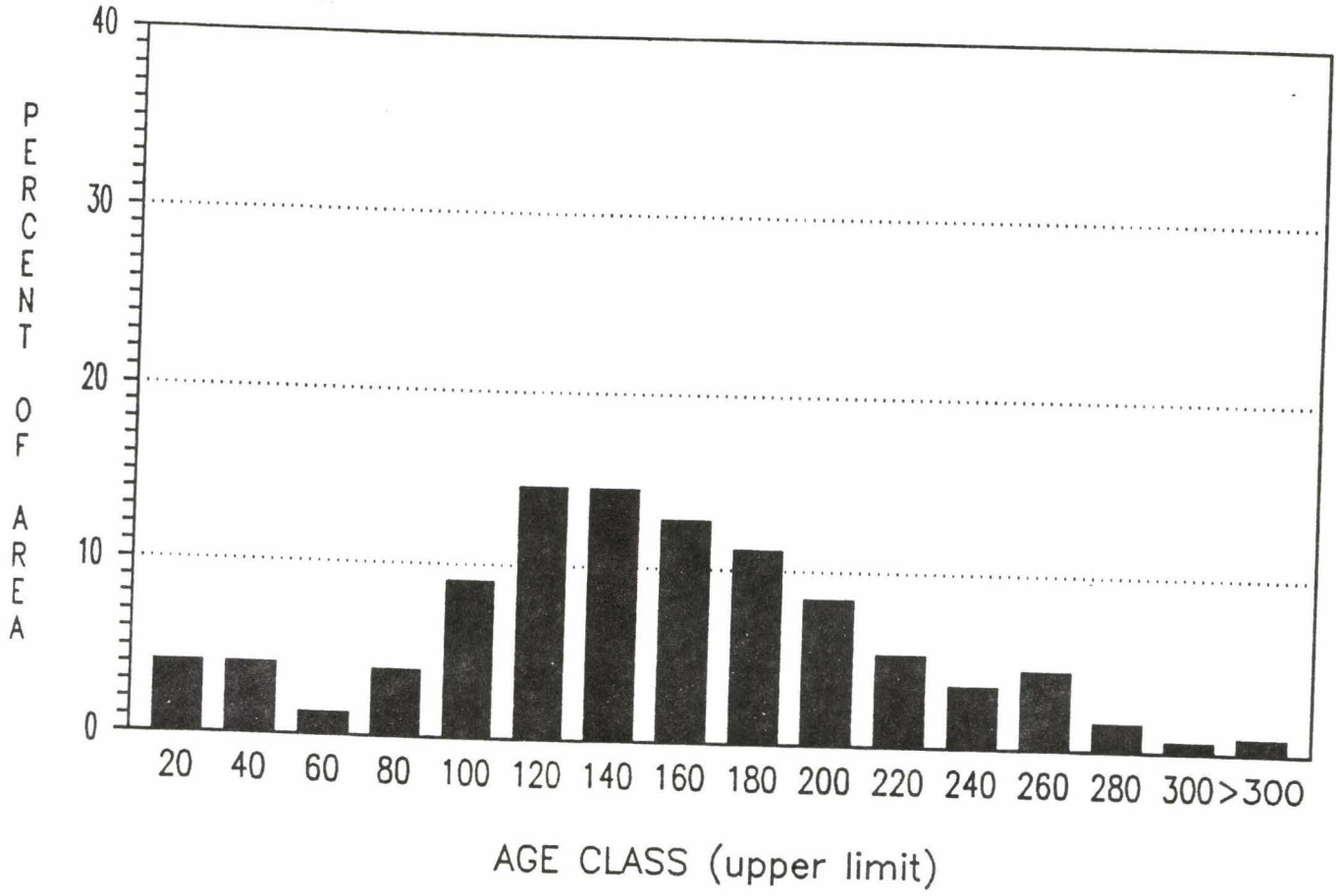

Figure 6: Percent of spruce/fir covertype by age class in Region 2.

On average, only 1.7 percent of the acres have been regenerated per decade over the past 80 years. Subalpine fir is not uncommon at 250 years of age and spruce at 500 years of age. This cover type is the most diverse in relation to age class distribution in the Region. The average annual volume harvested in the Region is about 46 million board feet (about 20.0 percent of the total Regional volume).

Spruce Beetle: Dendroctonus rufipennis (Kirby)

Spruce beetle populations and damage remained low throughout the Region. A small local population occurred mainly in road right-of-way decks and slash in sale areas in log decks on the Sulphur Ranger District, Arapaho and Roosevelt National Forests, Holy Cross Ranger District, White River National Forest, and Brush Creek Ranger District, Medicine Bow National Forest. The beetles are expected to enter additional slash and new logs but will be hauled and processed through the mill before the beetles mature.

The largest spruce beetle outbreak in recent history occurred on the Rio Grande National Forest between 1982 and 1984 when over 27,000 acres were riddled with beetle-caused mortality. Aggressive harvesting-employing trap trees, removal of high risk trees, early felling of over 1,200 trees, and unfavorable weather conditions helped terminate the beetle outbreak.

PINYON/JUNIPER COVER TYPE

There are 283,000 acres of pinyon/juniper on the National Forests in the Rocky Mountain Region. Most of these acres are non-commercial woodlands concentrated in southern and western Colorado.

Root Diseases: Ceratocystis wageneri Goheen and Cobb and Armillaria sp.

Black stain root disease, caused by Ceratocystis wageneri, is fairly common on pinyon pine in southern Colorado, especially in Mesa Verde National Park. Armillaria root disease can become widespread on Rocky Mountain juniper, especially following environmental stress. Sanitation is important to prevent Ips spp. (engraver beetle) build-up and to reduce fire danger.

URBAN AND SHELTERBELT TREE PROBLEMS

Diplodia Tip Blight of Pines: Sphaeropsis sapinea (Fr.) Dyko & Sutton

Successive years (1982-1986) of severe Diplodia tip blight has resulted in considerable damage, including mortality, to Austrian and ponderosa pines in eastern Nebraska. The damage has occurred primarily in older trees (over 30 years) in urban plantings (residential, parks) and windbreaks. Damage during these years has not been confined to new shoot growth; it has been extensive to older tissues, including mortality of major branches.

In Kansas, Diplodia blight is spreading from ornamental plantings in cities to windbreaks and recreation plantings. In South Dakota, the disease is scattered throughout ornamental and shelterbelt plantings, mostly occurring on ponderosa pine.

Dutch Elm Disease: Ceratocystis ulmi (Buism.) C.Mor.

This vascular wilt remains top priority for protection efforts in Colorado's urban forests. Dutch elm disease (DED) continues to be a problem throughout the Region in community plantings and in shelterbelts. The Colorado State Forest Service reported that there appeared to be a decrease in DED throughout the State in 1987. The major portion of the decline occurred from the lower Arkansas valley, including Canon City, Pueblo and the La Junta area.

NURSERY STUDIES

Reforestation Improvement Program (RIP)

The first 2-0 ponderosa pine crop from Bessey Nursery for the National RIP was lifted in Fall 1987. Mycorrhizal development was poor. Hopefully the site chosen for the spring outplanting will be good, so mycorrhizal development and seedling survival can be correlated.

Russian-olive Tip Blight

The tip blight of unknown etiology continues on 1-0 Russian-olive at Big Sioux Nursery, South Dakota. Pathogenicity tests at the FPM lab with Fusarium acuminatum, Alternaria sp., and bacteria isolated from blighted leaf and stem tissue have been negative. Regular applications of Benomyl alternated with Bordeaux mixture during the summer are keeping the disease under control.

Evaluation of Basamid

Beginning in 1986, fumigation with methyl bromide/chloropicrin was compared with application of Basamid Granular and soil solar heating for pre-plant pest control for fall-sown eastern redcedar at Bessey Nursery, Halsey, Nebraska. According to soil assays, water-sealed and polyethylene-sealed Basamid were as effective as methyl bromide for controlling plant parasitic nematodes. Solar heating was somewhat less effective for nematodes than the chemical treatments. Solar heating was more effective than polyethylene-sealed Basamid for control of Fusarium spp., while methyl bromide was the most effective. Weeds were controlled best by solar heating in this evaluation. Most of the seedlings sown in Fall 1986 were destroyed by frost in spring 1987, precluding any meaningful survival and growth data. Further evaluation is needed, with larger treatment areas and other conifer crops.

ROCKY MOUNTAIN REGION--SUMMARY OF INSECTS IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING

INSECT	HOST	LOCATION	REMARKS
Cankerworms *Alsophila pometaria* *Paleacrita vernata*	Elm Hackberry Honeylocust	Kansas	Severe in localized areas in eastern half of Kansas. Late freeze killed first foliage flush; cankerworms destroyed second flush; resulted in very late leafing out.
Cedar bark beetles *Phloeosinus* spp.	Eastern redcedar	Nebraska	Caused significant damage to redcedar windbreaks in eastern Nebraska.
Dioryctria pine moths *Dioryctria ponderosae* *D. tumicolella*	Ponderosa pine	Nebraska	Continue to be a problem of pines in central and western Nebraska.
Douglas-fir beetle *Dendroctonus pseudotsugae*	Douglas-fir	Colorado, Wyoming	The Douglas-fir beetle continues to infest areas that were heavily defoliated in the recent past. In some areas the beetle is attacking trees which were not defoliated.
European pine sawfly *Neodiprion sertifer*	Pine	Kansas	Reported again in a number of Christmas tree plantations in northwestern Kansas and around Kansas City in the eastern part of the State.
Jack pine budworm *Choristoneura pinus*	Jack pine	Nebraska	Severely defoliated 258 acres in one jack pine stand in the Bessey division of the Nebraska National Forest. Egg mass densities indicate that 1988 larvae populations in five stands will be sufficient to cause moderate to severe defoliation of jack pine.
Juniper Sawfly *Monoctenus fulvus*	Juniper	Kansas	Populations very low. For the first time in ten years, damage was not a problem in some areas of the state.
Large aspen tortrix *Choristoneura conflictana*	Aspen	Colorado	Populations appear to be subsiding.
Pine tip moths *Rhyacionia bushnelli* *Rhyacionia frustrana*	Austrian pine, ponderosa pine, Scots pine	Colorado, Nebraska, Kansas	In Colorado's Black Forest, infestations occurred on 47 acres. In Kansas, damage was severe in many Christmas tree plantations. In Nebraska, tip moth continues to be a problem in young pine throughout the State.

ROCKY MOUNTAIN REGION--SUMMARY OF INSECTS IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING

INSECT	HOST	LOCATION	REMARKS
Pine budworm *Choristoneura lambertiana*	Ponderosa pine, limber pine,	Colorado	Defoliation levels declined in southwestern Colorado.
Pine butterfly *Neophasia menapia*	Ponderosa pine	Colorado	In the Black Forest, 47 acres were defoliated.
Scale *Quadraspidiotus gigas*	Narrowleaf Cottonwood	Colorado	First time reported in the State. Detected in Buena Vista town park.
Terminal weevil *Pissodes terminalis*	Lodgepole pine	Wyoming	Newly discovered, scattered throughout two young stands on Buffalo Ranger District of the Bighorn National Forest.
Walnut caterpillar *Datana integerrima*	Walnut	Kansas	Damage was minor compared to previous years. Few reports of extensive damage.
Twig beetle *Pityogenes* sp.	Ponderosa pine	Colorado	Detected in 20 acres near Pinery in Douglas County. Infestations were apparently indicators of host stands in Dendroctonus - susceptible condition.

ROCKY MOUNTAIN REGION--SUMMARY OF DISEASES IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING

DISEASE	HOST	LOCATION	REMARKS
STEM AND BRANCH DISEASES			
Comandra blister rust *Cronartium comandrae*	Lodgepole pine	Wyoming	Continues as the most serious disease of lodgepole pine on the Wind River Ranger District, Shoshone National Forest, where more than half of the mature trees are infested and 85 percent of infected trees have dead tops.
Dwarf mistletoes *Arceuthobium americanum*	Lodgepole pine	Colorado, Wyoming	Remains the most important disease on Federal lands in the Region. Found on about 518,000 acres in Colorado and 361,000 acres in Wyoming, it causes mortality and growth loss equal to approximately 10 million cubic feet. Presuppression surveys were conducted on 3,554 acres on three National Forests. Silvicultural control was conducted on 4,468 acres on eight National Forests.
Arceuthobium vaginatum subsp. *cryptopodum*	Ponderosa pine	Colorado	Approximately 20 percent of the host type is infested. Annual losses amount to over 885,000 cubic feet. Most common in the *Pinus ponderosa/Muhlenbergia montana* habitat type. Approximately 10,000 acres of the Black Forest northeast of Colorado Springs was surveyed by the Colorado State Forest Service. Landowner concern about the disease in this area has been strong.
CANKERS			
Thyronectria austro-americana	Honeylocust	Kansas	Continues to be a problem in windbreaks.
Botryodiplodia spp.	Juniper	Kansas	Identified in the State for the first time by two Kansas State University pathologists.
Phomopsis or *Tubercularia* sp.	Russian olive	South Dakota	For the last few years, causing mortality in shelterbelts. Incidence highest in areas affected by drought and grasshopper populations.
Botryodiplodia hypodermia	Siberian elm	South Dakota	Declining and dying of elms throughout the State continues. Herbicide damage is suspected as one of the stress factors resulting in infection of trees by this fungus.

ROCKY MOUNTAIN REGION--SUMMARY OF DISEASES IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING

DISEASE	HOST	LOCATION	REMARKS
ROOT DISEASES			
Armillaria spp.	Subalpine fir, Engelmann spruce	Colorado	Several hundred acres near Turquoise Lake and May Queen Campground on the Pike and San Isabel National Forest, CO, contain clusters of small centers of Armillaria root rot.
Fomes annosus	Jack pine	Nebraska	Identified at a new location east of the Coyote sale on the Nebraska National Forest.
FOLIAGE DISEASES			
Gnomonia leptostyla	Walnut	Kansas	Incidence was high in the eastern half of Kansas. Trees lost most of their leaves prematurely and only late developing leaves were unaffected and remained on the trees in late August and September.
Gnomia platani	Sycamore	Kansas	Was very severe in many areas of northeastern Kansas. An extended cool period during the spring delayed bud break and favored the disease.
Ciborinia whetzelli *Marssonina populi*	Aspen	Colorado	Although found throughout Colorado, aspen were heavily infected in the southwest quadrant of the State. These diseases created great aesthetic concern.
Diplodia pinea	Ponderosa pine, Austrian pine	Kansas, Nebraska	Continues to be a problem in windbreaks and urban plantings. However, in Nebraska, infection was light in 1987. There was little or no rainfall during the period when new shoots were highly susceptible.
Scirrhia acicola	Scots pine	Kansas	Continues to increase in Christmas tree plantations.
Lophodermella concolor *Lophodermella montivaga*	Lodgepole pine	Colorado	Was noticeable on trees throughout the Sulphur Ranger District, Arapaho National Forest.
Phomopsis juniperovora *Cercospora sequoiae* *Kabatina juniperi*	Eastern redcedar, Rocky Mountain, juniper	South Dakota, Nebraska	Continues to be a problem in windbreaks.
Dothistroma pini	Austrian pine	Nebraska	Continues to be a problem in young pine plantings in eastern Nebraska.

ROCKY MOUNTAIN REGION--SUMMARY OF DISEASES IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING

DISEASE	HOST	LOCATION	REMARKS
WILTS AND DECLINE			
Ceratocystis ulmi	Elm species, including American elm	Colorado, Nebraska, South Dakota	Remains top priority for control in Colorado's urban forests. In areas serviced by the Colorado State Forest Service, disease incidence appears to have decreased. In South Dakota, the disease continues to kill 6 to 10 percent of the American elms in communities without management programs.
Bursaphelenchus xylophilus	Scots pine	Kansas	Reported for the first time in Johnson County, although known in other areas of the State.
Undetermined	Juniper	Kansas	Continual problem in windbreaks. Symptoms usually include tip dieback, branch mortality, or complete death of trees. Causal agent continues to be evasive.
NURSERY DISEASES			
Tip blight Causal agent unknown	Russian-olive	South Dakota	1-0 seedlings at Big Sioux Nursery continue to be damaged by a tip blight of unknown etiology. The blight is kept under control by regular applications of Benomyl alternated with Bordeaux mixture. Pathogenicity tests with *Fusarium acuminatum*, *Alternaria* sp. and bacteria isolated from diseased tissue have not resulted in any tip blight symptoms.
Damping-off *Fusarium* spp.	Scots pine, ponderosa pine	South Dakota	Heavy losses occurred in some study plots at Big Sioux Nursery.
Powdery mildew	Chokecherry	Nebraska	Mildew, which developed in mid-summer, caused no significant growth loss by fall-lifting for 1-0 chokecherry.
Chemical burn	Lodgepole pine	Nebraska	Uneven distribution of chemical fertilizer which was not watered in, resulted in clumps of stunted and reddened seedlings.
Phoma blight *Phoma* spp.	Ponderosa pine	Nebraska	Infection by *Phoma* spp. and necrosis of seedling stems occurred under soil-buildup caused by torrential rains in late June.
UNKNOWN ETIOLOGY			
Sprout dieback	Aspen	Colorado	Sudden mortality of few to several-year-old sprouts is scattered in aspen stands. Preliminary observations indicate some correlation with wet sites.

Use of herbicides in Region 2 for 1983-1987
(Major herbicide uses only)1/

Herbicide	Application Method	1983	1984	1985	1986	1987
		Acres treated				
2,4-D	Ground	1,011	1,971	2,243	2,857	2,592
2,4-D	Aerial	8,287	2/	2/	2/	2/
Picloram (Tordon)	Ground	2,151	2,782	2,452	3,167	2,769
Glyphosate (Roundup)	Ground	98	235	102	244	387
Dicamba (Banvel)	Ground	153	339	292	295	600

1/ Major target species are big sagebrush, sand sagebrush, Canada thistle, leafy spurge, Wyethia and various broadleaf weeds for range improvement and roadside management projects.

2/ No aerial application of herbicides in FY 84, 85, 86, or 87.

PESTICIDE USE IN REGION 2 IN FY 87 1/

Type of Pesticide	Chemical Used	Target Pest	Units Treated 2/
Fumigant	Methyl bromide/ chloropicrin	Nematodes in nursery beds	16
Fungicide	Benomyl	Phompsis canker in eastern red cedar nursery stock	76
	Bordeaux mixture	Diplodia tip blight	6
	Dodine	Shothole disease in nursery stock	5
	Zineb	Powdery mildew	1
Herbicide	Amitrol	Rights-of-way	58
	Dacthal	Nursery weed control	14
	Dicamba	Noxious weed control	600
	Diuron	General weed control	31
	Glyphosate	General weed control	10
	Glyphosate	Noxious weed control	340
	Glyphosate	Nursery weed control	26
	Glyphosate	Poisonous plant control	11
	Hexazinone	Noxious weed control	190
	Hexazinone	Range management improvement	1
	Oust	General weed control	31
	Oust	Noxious weed control	55
	Paraquat	General weed control	4
	Picloram	Noxious weed control	2,587
	Picloram	Poisonous plant control	128
	Picloram	Range management improvement	54
	Simazine	General weed control	238
	Tebuthiuron	Wildlife habitat improvement	70
	Tebuthiuron	Wildlife habitat improvement	20 trees
	2, 4-D	General weed control	6
	2, 4-D	Noxious weed control	488
	2, 4-D	Range Management Improvement	687
	2, 4-D/Dicamba	Noxious weed control	95
	2, 4-D/Dicamba	Poisonous plant control	28
	2, 4-D/Picloram	Noxious weed control	1,258
	2, 4-DP	Noxious weed control	30

Type of Pesticide	Chemical Used	Target Pest	Units Treated 2/
Insecticide	*Bacillus thuringiensis*	Mosquitos	1
	Carbaryl	Cottonwood leaf beetle	12 trees
	Carbaryl	Mountain pine beetle	250 trees
	Coumaphos	Mites	14,000 head of cattle
	Dimethoate	Tip moths	11
	Malathion	Grasshoppers	7,360
Rodenticide	Aluminum phosphide	Prairie dogs	29
	Strychnine	Pocket gophers	197
	Zinc phosphide	Prairie dogs	5,800
Piscide	Antimycin	Undesirable fish	10 acre feet
	Rotenone	Undesirable fish	65 acre feet

1/ Includes use by the USDA Forest Service, other Federal agencies, permittees, licensees, and grantees.

2/ Units are in acres unless otherwise indicated.

SHADE TREE RESEARCH (W.R. Jacobi)

Studies on the problem of stress and disease in honeylocust.

Water Stress Studies

Effects of drought and water stress on Thyronectria canker expansion are under study. Results to date generally show no significant differences in canker sizes between stressed and non-stressed trees. There is, however, a distinct trend in the data where non-stressed trees have larger cankers and stressed trees have smaller cankers as measured by bark death. Water stress reduces the growth of the canker pathogen Thyronectria austro-americana grown in vitro.

Root Collar Rot

Effects of overwatering honeylocusts is being examined. Prevention work involves the removal of soil around the tree base and replacing the soil with gravel. Results are not expected for several years.

Relationship of Soil Salt to Cankers

Colorado soils are high in the salts, calcium and magnesium. These could predispose honeylocusts to cankering. A study of the relationship of canker incidences and soil salt in a local nursery showed that salts could explain 35-36% of the variation in incidence of cankers. Greenhouse studies have been initiated to assess the effect of salt on canker expansion.

Fungicide Screening

Work continues on testing Bayleton, Benlate, Mancozeb, copper hydroxide, Funginex, Topsin M and Daconil 2787 for the prevention of Thyronectria cankers of honeylocusts and Marssonina leaf spot of aspen. Low concentration (1x, 2x and 4x) of fungicides appear to have no effect in preventing Thyronectria cankers. Preliminary results indicate good control of Marssonina leaf spot with most chemicals tested. Tests are to be repeated in the spring of 1988.

FOREST TREE RESEARCH

Cytospora Canker of Aspen (Annette Ramaley, Graduate Student).

Several studies on Cytospora canker of aspen are continuing: wound susceptibility, mode of entry of the pathogen and its presence or absence as a normal epiphyte. Also, work is continuing with Cytospora in the areas of water relations, local species and cultivar susceptibility to various isolates from different hosts and possibly oxygen-deficit stress.

Risk Rating for Commandra Blister Rust (Jane Boyd, Graduate Student).

Work continues in the development of a risk rating scheme for comandra blister rust in lodgepole pine. Five areas of research are being examined. Three of these are related to historical weather data to determining characteristics for potential infection periods. The other areas of research include: improving and validating existing growth and mortality equations and the utilizing of RMYLD and PROGNOSIS to determine the effects of different disease scenarios on forest productivity.

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